

Report to the Energy Efficiency Utility

Contract Administrator

Verification of

**EVT's 2006 Claimed Annual MWh Savings,
Coincident Summer and Winter Peak Savings
And Total Resource Benefit (TRB)**

Department of Public Service

Revised July 26, 2007

I. Introduction.....	1
II. Project- and Measure-Level Adjustments	5
A. <i>Business Existing Facilities: Custom</i>	5
1. Columbia Forest Products-Air Compressors.....	5
2. Holly Court Renovation – Lighting/HVAC	5
3. Montpelier Schools – Performance Contract	6
4. Stowe Mountain Resort - Snowmaking 2006	6
5. Founders Memorial School – HVAC Controls	7
6. NSA Industries - Punch Press	7
7. Progressive Plastics	8
8. Vermont Aerospace Manufacturing – CAS	8
9. Comfort Inn	9
10. Magic Hat Brewery CAS.....	9
11. Rock Tenn Company - Winder Drive Improvements	10
12. Saporiti Sandblast CA.....	10
13. Smuggler’s.....	10
B. <i>Business Existing Facilities: Prescriptive</i>	11
1. Inn At Willow Pond - Rx Lighting	11
2. Title: Champlain Farms Shell	11
C. <i>Business New Construction</i>	11
1. Hampton Inn – Bennington.....	11
2. Stop & Shop - Green Mountain Plaza	12
3. Burlington Airport	12
4. Magic Hat Chiller	13
5. Patricia Hannaford Career Center	13
6. Pilgrim Partners - Pilgrim 5 Bldg.....	14
7. Trapp Family Lodge - Fitness Center	14
8. Windsor-Orange County Credit Union.....	14
D. <i>Residential Multifamily</i>	15
1. Eastwood Commons, Building 2	15
2. Rising Bear Lodge – Stratton Mountain	15
E. <i>Residential Adjustments</i>	16
1. Efficient Products Program.....	16
2. Low Income Single Family and Residential Emerging Markets	17
III. Projects with Pending Adjustments	19
A. <i>CFL Measure Life</i>	19
IV. Issues to be Addressed on a Prospective Basis.....	19
A. <i>Documentation of Project Costs</i>	19
B. <i>Other Documentation Issues</i>	20
C. <i>EP Lighting Products</i>	21

<i>D. CFL Products in Lodging Establishments</i>	21
<i>E. Opportunities for Continuous Monitoring</i>	22
<i>F. Improved Tool Documentation</i>	22
<i>G. Manufacturing Facility Operation Schedules</i>	22
<i>H. CAS Leak Corrections</i>	22
V. Sampling Methodology	23

DPS Verification of EVT's 2006 Claimed Annual MWh Savings, Coincident Summer and Winter Peak Savings, And Total Resource Benefit (TRB)

**June 14, 2007
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I. Introduction

On March 1, 2007, Efficiency Vermont ("EVT") submitted its "Year 2006 Preliminary Annual Report and Annual Energy Savings Claim" for calendar year 2006 activities operating as the statewide energy efficiency utility ("EEU"). As provided for in the contract between Efficiency Vermont and the Vermont Public Service Board ("PSB"), the Department undertook a review of EVT's 2006 activities, verifying the energy savings, coincident peak savings and Total Resource Benefit ("TRB") amounts claimed by EVT. This report made to Michael Wickenden, Contract Administrator for the PSB, summarizes the results of that review.

The DPS provided preliminary findings to EVT and the Contract Administrator on May 25, 2007. On June 4, 2007, Efficiency Vermont provided a response to the DPS preliminary findings on items where the DPS recommended an adjustment to the 2006 savings claim. Agreement on savings adjustments was reached for all of the items identified in the DPS preliminary findings.

EVT has indicated it accepts all of the adjustments to the 2006 claimed savings recommended by the Department in this report. In some cases, EVT does not completely agree with the Department's rationale or methodology for the adjustment, and requests that the measure characterizations for 2007 be discussed more thoroughly through the ongoing DPS-EVT TAG process. The Department has also identified some topics to be taken up in TAG process, as outlined in Section IV, Issues to be Addressed on a Prospective Basis.

Since the parties are in agreement on the magnitude of the 2006 adjustment, the issues and resolutions are briefly described. More discussion is provided for the current and ongoing issues described in Section III. For more detail about the adjustments, please refer to the Department's May 25, 2007 preliminary findings and EVT's June 4, 2007 response.

The Department continues to place a high value on EVT's leadership in promoting energy efficiency among Vermont's citizens and businesses, particularly in the context of the renewed interest in energy conservation and increasing concerns regarding the impacts of climate change due to carbon dioxide emissions. EVT provides a valuable resource for Vermont, both in terms of supporting our economy by expanding the infrastructure to

deliver energy efficiency services and providing the groundwork for moving our state toward greater energy independence.

The results of the Department's verification to date suggest that the claimed 2006 savings are overstated by about 6.2% or 2,888 gross annualized MWh.¹ This result represents a substantial improvement over the 2004 and 2005 verifications. In particular, the Department noticed that there were fewer large projects with very high savings in 2006 as compared to the previous years. It was often the largest projects that also had the most substantial errors, and the lower incidence of very large project may be an indication of improved internal review at EVT.

While gross, annualized kWh is the primary metric reported in this document, the review also covers summer and winter coincident peak demand, net energy and demand savings, TRB, MMBtu savings from fossil fuels, and water savings. Many of the energy adjustments also have significant impacts on these other indicators. For example, the adjustment in cooling savings for a multifamily Residential New Construction project may well have a disproportionately large impact on the summer coincident peak savings for that program. A few adjustments are targeted primarily at these other indicators, such as a free rider adjustment relating to an industrial process measure. When EVT's savings are revised for its 2006 annual report, all of the relevant indicators will be re-calculated.

Similar to the process undertaken for the 2004 and 2005 verifications, the Department is basing its recommendations on the review of a random sample of C&I projects. This process was designed to ensure that the sample was weighted toward the larger projects that embody greater variability and more complex methods for calculating savings. Since the projects under review are reasonably representative of EVT's 2006 activity, the DPS is proposing a proportional adjustment to the C&I savings. This sampling and adjustment method should reflect what would otherwise result from a comprehensive savings review of all C&I projects, if resources and time permitted that approach.

Since many of the residential initiatives are primarily prescriptive in nature, the Department's review of this sector consisted largely of verifying that the agreed-upon savings as compiled in EVT's Technical Reference Manual (TRM) were correctly applied. This validation process could be easily conducted for the entire data set, obviating the need for random sampling. The remaining initiatives are relatively small in magnitude and the Department primarily reviewed the larger projects with higher savings.

The adjustments relate to individual projects and also to methods and tools applying to whole categories of projects. In contrast to previous years, the adjustments are distributed throughout the smaller and larger projects. For example, in the BEF initiative, adjustments were made to twelve projects, evenly divided among the three upper sampling strata. Only the stratum with the smallest projects had no adjustments. The same general pattern holds for the BNC, with one adjustment found in the lowest stratum.

The random sample consisted of 81 C&I projects covering the range of EVT initiatives in this sector. The Department is recommending adjustments based on twenty-four of these projects. The remaining projects fall into three categories: 1) no problems were identified, 2) the problems were such that the Department concluded they could be

¹ The results of the DPS review are quantified as reductions to annualized kWh or MWh gross savings at the customer meter. The EVT contract savings goals are expressed in MWh savings at generation, net free ridership and spillover effects. For this reason, these amounts are approximate and will be finalized by EVT when the changes are entered into the tracking system.

addressed on a prospective basis or 3) there was insufficient documentation to determine if the savings estimates are reasonable. Although EVT has made improvements to the documentation, these procedures do not seem to be consistently applied across all projects and the Department continues to be concerned about the lack of documentation available for some projects. For the 2006 verification, no savings adjustments are proposed due to lack of documentation. The Department will review this issue and consider alternatives for the 2007 verification.

In addition, seven multifamily projects were reviewed, including the two largest projects and five randomly selected from the remaining projects. Adjustments were made only to the two largest projects, and thus it was not necessary to establish a realization rate for the whole group of MFB projects. The adjustments to the two reviewed RNC projects are included in the overall results.

The sampling and adjustment process is described in more detail under “Sampling Methodology.”

Table 1: Summary of Adjusted Projects

	Total # of Projects	# Of Projects in Sample	# Of Projects with Adjustments
BNC	86	24	9
BEF Custom	290	46	13
BEF Prescriptive	455	15	2
Totals	831	81	24

The adjustments to gross annualized savings (kWh savings at the customer's meter) for all sectors are summarized in Table 2. The relative precision for the realization rates associated with the custom Business Existing Facility (BEF), prescriptive BEF and Business New Construction (BNC) projects is 12.3%, 2.2% and 10.4% at the 90% confidence level, respectively. As in the 2004 and 2005 verification reports, the realization rate for the top tier of projects in each group was calculated separately.

Table 2: Summary of Adjustments

	# of Projects	Claimed MWh Savings	Realization Rate	MWh Adjustment	% Reduction
C&I					
BEF Top 10	10	5,565	79.0%	1,168	21.0%
BEF Custom	263	10,304	92.0%	827	8.0%
BEF Pres Top 5	5	671	98.7%	8	1.3%
BEF Prescriptive	450	2,250	99.6%	9	0.4%
BNC Top 5	5	1,399	90.4%	135	9.6%
BNC	80	2,592	91.9%	210	8.1%
Subtotal	813	22,780	89.7%	2,357	10.3%

Residential					
LISF/REM		3,961	96.6%	134	3.4%
EP		17,523	97.9%	361	2.1%
RNC		1,964	98.2%	35	1.8%
Subtotal		23,448	97.7%	544	2.3%
Totals		46,228	93.7%	2,888	6.2%

The remainder of this report is divided into four sections. Section II details project and measure-level issues that provide the basis for the adjustments shown in Table 2 above. Section III supports an adjustment in the measure life for CFL's installed through the Efficient Products program, to be calculated by EVT. In Section IV, we discuss specific issues with program year 2006 (PY06) projects and other concerns to be addressed on a prospective basis. The final section describes the sampling methodology in more detail.

II. Project- and Measure-Level Adjustments

A. Business Existing Facilities: Custom

1. Columbia Forest Products-Air Compressors

Project ID: J00000222638
MAS90: 6013-5307
Measure IDs: M00000875178-80
Stratum 4

EVT installed a variety measures designed to reduce the energy required for making compressed air. Columbia Forest was chosen by the DPS as one of three candidates for an on site inspection. DPS representatives conducted the site visit on May 1, 2007 and all of the EVT recommendations were verified as completed. The facility manager was extremely satisfied with the results and plans several projects in the near future.

When estimating the savings, EVT assumed that the plant would be operating exactly at the required capacity (90 psi), which seems overly optimistic. At the time of the site visit, the DPS representative noted that the plant was running at 100 psi, which does not seem unreasonable or unexpected under the circumstances.

Adjusting the efficient condition from 90 to 100 psi results in a total reduction of 57,851 gross annualized kWh.

2. Holly Court Renovation – Lighting/HVAC

Projectid: J00000226632
MAS90 Project: 6013-6138
Stratum 4

This large building (164,000 sq. ft.) was originally occupied by one occupant and was renovated for four different tenants, each with very different occupancy requirements as far as lighting is concerned. EVT estimated lighting savings using a fixture-by-fixture approach, whereas the Department concluded this major renovation project met the criteria for applying the space-by-space lighting power density (LPD) method, consistent with the guidelines set forth in the file named “#11 LPD Guidelines,” an EVT memo dated October 23, 2006 outlining the EVT New Construction Guidelines for Lighting Savings Calculations. In addition, a cooling bonus was added for spaces with no cooling and a hours of operation were overstated for some of the areas.

Given the available information, the DPS applied the Building Area Method LPD allowance for each specific building area type to recalculate the savings, resulting in a reduction total energy savings of all lighting measures by 821,999 gross annualized kWh, from 1,057,307 to 235,308 kWh.

3. Montpelier Schools – Performance Contract

Projectid: J0000024303
MAS90 Project: 6012-4270
Stratum 4

This project encompasses three schools: Union Elementary School, Main Street Middle School and Montpelier High School. The schools have a performance contract with Honeywell. The efficiency improvements in this project consist of a significant number of prescriptive lighting measures with occupancy sensors installed on some of the efficient lighting. There are also “improved space heating controls” installed in each school with savings calculations provided by Honeywell.

Honeywell is an ESCo and is guaranteeing energy savings for this project. They will closely monitor the installed systems and train the school personnel to operate the energy saving equipment properly. For many measures, EVT based their energy savings estimates on Honeywell’s savings calculations.

The baseline assumption for the motors in the air handling system for the space heating system is a 24/7 operation throughout the year (8,760 hours) for most of the motors. It is more realistic to assume that the heating system for the schools is off for at least two months of the year. Consequently, the assumed baseline hours of operation have been reduced by a factor of 10/12.

There is one lighting measure, for the sink rooms in the middle school that assumes 8,760 hours of operation annually. This assumption should be reduced to 3,000 hours per year, as is more consistent with the other lighting measures and the school schedule.

Adjusting the hours of operation for the three space heating control measures reduces savings by a total of 78,367 gross annualized kWh. For the lighting measure, savings should be reduced by 1,089 kWh.

4. Stowe Mountain Resort - Snowmaking 2006

Project ID: J00000230089
Mas90:6012- 6606
Stratum 4

This project installed 100 snow guns on existing trails. The compressed air savings were based on mountain-specific test data. The compressed air savings were divided into electric and diesel savings based on existing mix of diesel and electric compressor capacity. This project was selected by the DPS for a site visit. On May 10, two DPS representative went to the Stowe Mountain Resort and observed the conditions first hand.

It is clear from the project files that this project received a good deal of scrutiny. Broad and in-depth questions were asked and answered as evidenced in MJ Poynter’s memo responding to Erik Brown’s questions. The DPS appreciates the time and effort put into this project by EVT staff.

The Department agrees with the overall approach and inputs used to calculate the savings. The only issue is how the savings were broken out by fuel type (diesel and

electric). Both diesel and electric compressors are used at the mountain for snowmaking and the more efficient snow guns will undoubtedly avoid both fuel types at different times.

EVT used the historical diesel/electric mix of compressor capacity for estimating savings. This approach is problematic because it does not properly account for the actual operating conditions. The average mix of fuel types over a specified period does not necessarily reflect the marginal use of one compressor over the other. After the efficient snow guns were installed, the operations manager will be able to shut down one or more compressors at certain times. The relevant question is which compressors will be turned off.

In Stowe's case, there is a clear operating strategy for choosing the compressors to take off line. The operations manager stated that when the compressed air load drops, the diesel compressors are shut off first. The electric compressors are run preferentially as the electric load allows, i.e., they are run as much as possible whenever possible. One also has to take into account that Stowe's arrangement with its electric utility requires it to cut back on its electric load whenever the entire town of Stowe nears its pre-specified cap on demand.

Thus, the decision to use or not use the electric compressor has less to do with the efficiency of the snow guns than with these external conditions. Consequently, it is appropriate to account for this operational practice when estimating the diesel/electric split.

The Department has adjusted the electric savings to one-half of its historical operation. These adjustments result in a decrease of 208,380 gross annualized kWh and an increase of 2,763 MMBtu of diesel fuel.

5. Founders Memorial School – HVAC Controls

Projectid: J00000227138
MAS90 Project: 6012-6232
Stratum 3

This project consists primarily of a very large custom motor control measure for the supply and return fans for the school's HVAC system. According to the project overview, this HVAC system was running year-round, 24 hours a day, to heat and ventilate the school.

For the custom control measure, the savings were calculated using a baseline assumption of heating system operation of 8,760 hours per year. This assumption seems unrealistically high for a school, and EVT agrees that the heating system is likely to be turned off at least two months a year, resulting in a reduction of savings of 10/12.

The revised savings estimate is 68,301 kWh (including a 20% commissioning adjustment per the TRM), for an adjustment of 43,678 annual kWh.

6. NSA Industries - Punch Press

Project ID: J00000222353
Mas90: 6012-5275
Stratum 3

This project involved the installation of a new, larger punch press machine. The new machine is faster, more efficient, and larger. Since the machine is larger, pieces can be punched without re-positioning as is required on the pre-retrofit, smaller presses.

The hit rate (hits per minute) varies by machine and position. To compare the energy usage on an equal-production basis, the baseline and efficient scenarios should represent the same number of “hits” per year. However, EVT's savings calculation has different number of “hits” for the baseline than for the efficient equipment, and thus the equipment choices are not being compared on an equal footing. Also, the savings calculation appears not to account for the time spent re-positioning items on the old machine.

The savings calculation was revised to (1) match the hits/day between the pre-retrofit and proposed machines and (2) reduce the operation of the pre-retrofit machines by 30% to account for the time spent re-positioning. These adjustments result in a decrease of 33,829 gross annualized kWh.

7. Progressive Plastics

Project ID: J00000208249

Mas90: 6013-3780

Stratum 3

In this project, the participant purchased two new all-electric injection-molding machines to replace two hydraulic injection-molding machines. The Department found two problems with the savings estimates for this project: a) the savings claimed as a percentage of the estimated use of the hydraulic machines is higher than supported by the manufacturer's claims and by EVT's metering of other, similar projects, and b) the equipment used as the baseline by EVT is no longer in production, raising questions about the market acceptance of this technology.

The Department accepts EVT's revised savings claim of 118,217 kWh, which is a reduction of 50,051 kWh compared to the original claim. In addition, the Department recommends that the free rider rate for this project be increased from 6% to 50%. Due to logistical constraints, the free ridership adjustment may be made to the gross savings, resulting in a total reduction of 105,387 gross annualized kWh.

8. Vermont Aerospace Manufacturing – CAS

Project ID: J00000209553

MAS 90: 6013-3864

Stratum 3

EVT made final adjustments to this project in a revised CAT tool. Unfortunately, the original calculations were uploaded to the database and were not revised when the final adjustments were made, as explained in a note by EVT found in the file folder.

The DPS appreciates EVT's forthrightness in explaining this error. Correcting the savings for the air compressor measure reduces the gross annualized savings from 208,199 total kWh to the revised figure of 116,385 kWh, for a reduction of 91,814 kWh.

9. Comfort Inn

Project ID: J00000227078

MAS90: 6013-6211

Stratum 2

The Comfort Inn purchased 1,100 CFL bulbs through the Business Existing Facilities custom track. Of these products, 800 were 25 W CFLs for room fixtures and 300 were 5W Candelabras for the lobby chandeliers. There are 107 rooms at the inn and each room had 6 locations where bulbs were installed for a total of 642 of the 25 W CFLs. The remaining ~20% were for stock. The savings for the in-room bulbs were estimated at 4 hours per day, 50% occupancy. Savings are claimed for all of the bulbs and it appears that a 90% in service rate (ISR) was applied. It is unclear how many of the 5 watt bulbs went into stock.

Since it seems unlikely that all six bulbs in the room will be on for a total of four hours per day when the rooms are occupied, a "diversity" factor should be added to account for the actual use of the in-room bulbs.

On other projects with large purchases, EVT had documented that some are "stocked" for later use. In this case, the DPS has recommended that first year savings should not be claimed for the bulbs, but an adjustment to the measure life is appropriate. It is also highly likely that some of the 300 candelabra bulbs were for stock. These are installed in the lobby chandelier and it is unlikely that management would want to be in a position of not having replacements.

Finally, the total kWh savings entered into the database were slightly higher than the assumptions in the CAT tool support.

The Department adjusted the savings to add a 25% diversity factor for the in-room bulbs, a 20% stocking percentage both the in-room and candelabra bulbs. Making these adjustments reduces gross annual kWh savings from 65,079 to 50,324 annual kWh, for a total reduction of 14,755 gross annualized kWh.

10. Magic Hat Brewery CAS

BEF Custom

Project ID: J00000223439

MAS90: 6013-5631

Measure ID: M00000874544

Stratum 3

An air compressor with a variable speed drive rated at 185CFM@125 psi was installed. The savings were based on operating hours of 6,000, however the hours of use in the CAT tool are given as 4,160. Discussions with the project manager indicate that the machinery was in use for over 6,000 hours during the last year. This discrepancy in the hours of use entered into the CAT tool will overestimate coincident peak demand savings.

At the Department's request, EVT recalculated the demand savings using 6000 hours (and a three-shift load profile) and concluded that winter coincident peak demand savings should be reduced by 3.5 KW and summer peak savings by 4.9 KW.

11. Rock Tenn Company - Winder Drive Improvements

Project ID: J00000227883

Mas90: 6012- 6379

Stratum 2

A variable frequency drive on a winder motor was installed in this project. The savings occur during the idling time and the pre-retrofit load during idle was based on amperage draw. However, relying on amperage alone neglects the change in power factor at low load.

The savings calculation was revised account for the lower power factor at low load, resulting in a decrease of 42,902 annual kWh.

12. Saporiti Sandblast CA

Project ID: J00000224537

Mas90:6013- 5667

Stratum 2

This project replaced an air compressor with a VFD-driven air compressor. The performance of the proposed air compressor is based on manufacturer's data, which is approximately equal to the performance of a theoretical compressor as shown in the DOE curves in the file.

The savings calculation was revised to use the standard VSD performance provided in the DOE curves where VSD performance is offered (above 40% load). Otherwise, the best available performance is used as a surrogate for VSD performance. This adjustment results in a decrease of 21,354 annual kWh.

13. Smuggler's

ProjectID: J00000221017

Mas90: 6013-5083

Stratum 2

This project installed a more efficient centrifugal air compressor instead of two smaller rotary screw compressors for snowmaking operations. The savings calculations are based on the horsepower of each compressor at full-load and an expected 720 hours of operation.

The power draw of a compressor varies depending on load and can reasonably be expected to average less than full load. However, EVT's calculations assume it will always run at full load. Also, the base case has the advantage that one of the two compressors could be shut off under low load conditions.

The DPS understands that snowmaking operations tend to operate compressors near full load, and also that compressor power is not linear with load. Accordingly, the DPS recommends a modest 3% reduction in savings, resulting in a reduction of 3,075 gross annualized kWh/yr.

B. Business Existing Facilities: Prescriptive

1. Inn At Willow Pond - Rx Lighting

Project ID: J00000227252
MAS 90: 6013 6278
Stratum 3

The Inn purchase 735 screw-in CFLs. Nine of these lamps were installed in each of the 40 guest rooms at the Inn for a total of 360 bulbs. The rest were installed in a variety of locations such as the restaurant, conference rooms, exterior, etc. EVT assumed a 50% occupancy and 4 hrs a day for the lamps installed in the rooms and calculated a weighted average hours of use for these lamps and the other lamps. It appears that an in-service rate was applied.

It is unlikely that all nine lamps installed in a room would be used for four hours when the room is occupied, and consequently a diversity factor of 50% seems appropriate in this situation. Using EVT's blended hour approach and adding a 50% diversity factor to the room bulbs reduces the savings by 8,482 kWh/Yr.

2. Title: Champlain Farms Shell

Projectid: J00000224152
MAS90: 6013-5579
Stratum 2

This project was one of many refrigeration projects with Champlain Farms this year. The vendor on these projects provided EVT with information on the actual wattages of door heaters and evaporator fans for each individual project. EVT substituted the default values used in the TRM calculation to provide an estimate of savings for each installation. EVT also provided a note in the file stating that 6 rather than 3 evaporative fans were entered into the CAT tool resulting in a miscalculation of savings.

The Department appreciates EVT's correction on the number of fans. It is unclear whether EVT's use of the vendor estimates of hours properly account for interactive effects between evaporative fan motors, motor controls and economizer.

The Department accepts EVT's proposal to adjust the total savings for these measures from 22,904 to 21,876 kWh/yr.

C. Business New Construction

1. Hampton Inn – Bennington

Projectid: J00000018470
MAS90: 6014-1676

Stratum 4

This custom project involves a new Hampton Inn in Bennington. The Department corrected savings for a variety of measures, including CFL's installed in the guest rooms, high efficiency water heating equipment, PTAC units, and roof insulation.

Lighting assumptions for CFL's installed in the guest rooms were adjusted to be consistent with other hotel projects, i.e., four hours per day and 50% occupancy. In addition, a 50% diversity factor was applied to account for the fact that nine lamps were installed in each guest room.

The fossil fuel savings claimed for the high efficiency water heating equipment were adjusted to account for a 50% occupancy factor, and the baselines for the PTAC units and the roof insulation were corrected to be consistent with the Act 250 guidelines.

For lighting measures, adjusting the hours and accounting for occupancy and diversity factors results in a reduction of 98,608 kWh per year. Using the correct Act 250 baseline savings reduces claimed air conditioning savings by 14,050 kWh per year and roof insulation savings by 1,758 kWh per year (59 MMBtu of fossil fuel) per year. Revising the water heating savings for the occupancy factor results in a reduction 34 MMBtu of fossil fuel savings per year.

The total reduction for this project comes to 114,415 gross annualized kWh and 93 annualized MMBTU.

2. Stop & Shop - Green Mountain Plaza

Projectid: J00000226339

MAS90: 6014-6089

Stratum 4

This custom project involves the new construction of the Stop & Shop - Green Mountain Plaza. The project incorporated a variety of energy efficiency measures for the building's lighting and mechanical systems.

The calculation of the LPD lighting savings was done in a separate spreadsheet, but the claimed savings do not match the spreadsheet savings. In addition, EVT's hours of use were higher than supported by the guidelines used for calculating LPD savings. The Department also found that MMBtu savings associated with the high efficiency lighting were omitted from the database.

The total reduction for this project comes to 20,234 gross annualized kWh. In addition, fossil fuel savings should be increased by 314 MMBtu to account for the waste heat adjustment associated with the lighting efficiency measures.

3. Burlington Airport

Projectid: J00000218907

MAS90 Job: 6014-4937

Stratum 3

Measure: Insulation

This is a custom project involving new building construction at the Burlington Airport. The project incorporated a host of energy efficiency measures for the building's envelope, lighting and mechanical systems.

One measure involved additional insulation installed in the wall between a heated and cooled office and a semi-heated hanger. For this measure, kWh savings for reduced cooling and fossil fuel savings for reduced heating were claimed. However, this measure did not pass the cost effectiveness test performed in the CAT tool, and no savings should be claimed for measures that are not cost effective.

Both the kWh and fossil fuel savings should be reduced to zero for this measure, which results in a 61 kWh and 65.7 fossil fuel MMBTU annualized reduction.

4. Magic Hat Chiller

Project ID: J00000226605

Mas90: 6014-6134

Stratum 3

Measure: VFD pumping

This project installed variable frequency drives on two secondary chilled water pumps. Presumably one pump operates and the second is for maintenance backup. The base case is constant flow year-around and the proposed case is to vary the speed of the pump to maintain a constant 10° F temperature difference between leaving and returning chilled water temperature. The savings calculation is based on reducing the flow from 350 gpm to a range of 200 to 250 gpm, depending on outdoor ambient conditions.

The pump needs to be able to deliver 350 gpm. Prior to the retrofit, a 7.5 hp pump provided service. However, the savings were estimated assuming that the 20 hp pump was required to provide 350 gpm. The nameplate 20 hp was used in the calculations, results in an overstatement of savings for two reasons.

- The pump should not be expected to operate at the nameplate hp, even at full capacity, and
- The pump was assumed to provide 350 gpm at full capacity, whereas a 20 hp pump will be capable of providing 700 gpm, as is documented in the project file.

The DPS revised the savings calculation to model the pump head assuming that 20 hp pump would be required to provide 700 gpm, and the pump would actually run at 18 bhp rather than the nameplate 20.

These adjustments result in a decrease of 44,492 gross annualized kWh.

5. Patricia Hannaford Career Center

Projectid: J00000212371

MAS90 Project: 6014-4118

Stratum 2

This project involves a new auto diesel campus for Patricia Hannaford Technical School System. The project includes space-by-space lighting density measures among others. The incorrect baseline was used for the office lab space.

The savings associated with the LPD measure should be lowered by 3,110 kWh to 22,195 kWh to account for correcting the office lab space lighting density.

6. Pilgrim Partners - Pilgrim 5 Bldg

Projectid: J00000221730
MAS90 Job: 6014-5184
Stratum 2

This project involves construction of the Pilgrim Partners Building 5. The project incorporated lighting and HVAC energy efficiency measures. The savings for the lighting efficiency measures were calculated based on the space-by-space LPD method. However, the LPD methodology was not consistently applied to all of the spaces in this project. Three of the spaces had a higher LPD than allowed, hence had negative savings. But EVT did not account for this negative savings and only claimed savings on the spaces that had positive kWh savings. The proper method would have incorporated both the higher LPD spaces with negative kWh savings and the spaces with lower LPD and positive savings, to derive an overall kWh savings for these measures that reflected what was installed in the project.

Taking into account the spaces with higher than allowed LPD results in a reduction of 15,625 annualized kWh.

7. Trapp Family Lodge - Fitness Center

Projectid: J00000008525
MAS90 Job: 6014-1437
Stratum 2

This is a custom project involving the construction of the Trapp Family Lodge Fitness Center. One of the efficiency measures included lighting occupancy sensors, and the savings were overstated by a factor of six due to a clerical error in entering the measure into the CAT tool.

Another lighting efficiency measure included the installation of four exterior 26 W CFL fixtures. Whereas the baseline was assumed to be 100 W incandescent fixtures, using incandescent fixtures as the exterior lighting baseline for an Act 250 project is inappropriate.

Savings for the occupancy sensors should be reduced by 4,320 kWh. No savings should be claimed for the exterior CFL fixtures, for a reduction of 1,261 kWh. The total reduction for this project is 5,581 gross annualized kWh.

8. Windsor-Orange County Credit Union

Projectid: J00000217757
MAS90 Job: 6014-4827
Stratum 2

This project involved the construction of the Windsor-Orange County Credit Union and includes two lighting efficiency measures, i.e., one interior LPD measure and one

exterior fixture-by- fixture measure. The Department disagrees with the baseline used for the LPD measure. Applying the correct baseline indicates that no savings should be claimed for this measure.

The savings for the exterior canopy lighting included the waste heat factor and used the C&I lighting load shape with the cooling bonus, which is inappropriate since the canopy is located outside.

Total reduction of savings for this project is 2,608 annualized kWh. In addition, the canopy lighting should be rescreened with the appropriate load profile.

D. Residential Multifamily

1. Eastwood Commons, Building 2

RNC Project

Projectid: J00000214270

MAS90 Project: 6019-4565

Stratum 2

This is a multifamily new construction project consisting of 74 market-rate housing condos. A custom analysis was completed using the REM tool for the measure called comprehensive heating system and shell improvement. This project also included the installation of water source heat pumps (“WSHP”) with cooling tower heat rejection and condensing boiler heat injection.

The Department has substantial questions regarding the baseline, modeling and documentation of this project. Insufficient information was provided to assess the validity of the modeling and the results. The Department intends to address the baseline and documentation issues through the TAG process in 2007.

In the absence of better information, the Department has made two reductions to the savings. The first issue relates to interactive savings between the shell and cooling efficiency measures. The shell measures were modeled using a baseline WSHP cooling system and the prescriptive WSHP measure claimed savings for improving the efficiency of the cooling equipment, which ignores the interactive effects. The Department has reduced the cooling savings from the shell measures by 20% to account for these overlapping savings.

In addition, the prescriptive WSHP measure includes savings for both cooling and heating. The Department has concluded that only the cooling savings should be counted. Given that the heat source for the heat pump is a condensing boiler, a higher efficiency heat pump is unlikely to result in lower heating use.

The savings for this project should be reduced by a total of 29,200 gross annualized kWh.

2. Rising Bear Lodge – Stratton Mountain

RNC Project

Projectid: J00000020179

MAS90 Project: 6019-1046

Stratum 2

This is a residential, multifamily new construction project including lighting, motor and appliance measures as well as air conditioning and occupancy sensor measures. In the project files, communications for this project started in 2003, with some incentives for measures installed in 2004. There was a two-year lag in the project attributed to customer contact turnover. Savings in this project are prescriptive.

The waste heat adjustment was incorrectly taken for efficient lighting installed in a parking garage.

The interactive effects between the high efficiency motor measure for the exhaust fan motors and the demand controlled ventilation measure for the garage exhaust fans controlled by CO sensors were not correctly addressed. While the motors were upgraded to 87.5% efficiency, a motor efficiency of 86.5% was used for calculating the savings from the CO controlled garage ventilation measure.

The total reduction in savings for this project comes to 5,360 annual kWh.

E. Residential Adjustments

1. Efficient Products Program

a) Hollow Inn

Project ID: J00000206861

SiteID: S00000054237

Nine-hundred and five (905) bulbs were purchased by the Hollow Inn through the Efficient Products Program during 2006. Program guidelines put a cap of 25 bulbs per customer for commercial purchases. Savings were claimed using the efficient products commercial lighting assumptions for most of the 905 bulbs, which is based on approximately 9 hours of use per day.

This purchase should have been handled through the prescriptive track of the Business Existing Facilities initiative. EVT staff contacted the manager of the Hollow Inn and discovered that nine bulbs were installed in each room (41 rooms total) and some other undetermined number were installed in common areas. The hotel manager also stated that hotel patrons remove a certain percentage of bulbs installed in the rooms.

Using the commercial hours-of-use for bulbs installed in hotel rooms is not a reasonable assumption. In the past, EVT has used four hours per day, and then adjusted it for occupancy rates. When the nine bulbs are installed per room, it is appropriate to apply a diversity factor as discussed above under the Comfort Inn.

The Department recalculated the savings assuming that the in-room bulbs are in use four hours per day with 50% occupancy and 50% diversity. In addition, with such a large quantity of bulbs installed, 20% should be considered stocked, and at least another 5% lost to removal by patrons. Making these adjustments reduces gross annual kWh savings from 144,785 to 57,015, for a total reduction of 87,770 kWh.

b) EP Over-Limit Purchases

EVT establishes limits on the number of CFL products purchased each year. Each customer (or utility account) has a purchase limit of 6 CFL bulbs for residential and 25 bulbs for commercial use. However, it appears that many customers are ignoring these limits.

Many of these purchases are identified as commercial and consequently are accorded higher savings. There are at least two major sources of uncertainty in the prescriptive savings applied to these customers: 1) whether the actual hours of operation support the use of the 9 hours per day assumed for the commercial bulbs and 2) whether they are actually put into service or stored as replacements.

Consequently, the DPS has concluded that purchases of this size and scope are not appropriate in the context of the prescriptive approach to savings estimated used for the EP program. These purchases require additional information to determine actual conditions, operating hours and stocking practices for the custom estimation of savings.

The Department has made an adjustment based on 56 specific accounts that could be identified through EVT's tracking system. The actual scope of over-limit purchases could be much broader than indicated by these numbers. This analysis is not a comprehensive list of the customers with over-limit purchases found in the database, and many bulbs are sold through the "buy down" process where no tracking of the purchases by account is done.

The Department recommends the savings for these 56 accounts be reduced by 30%, for a total reduction of 273,555 annualized kWh.

2. Low Income Single Family and Residential Emerging Markets

a) Title: REM Project 5342

Projectid: J00000221913

MAS90 Project: 6036-5342

This project involved air sealing and insulation upgrades in the ceiling and crawlspace. Heat Loss calculations were used to estimate the savings for these measures. Total annual savings claimed is 6,975 kWh.

Savings claimed are about 70% of the total space-heating load. This estimate seems to be an unreasonably high percentage of the space heating consumption. The DPS would not expect savings to be greater than 40% of the total heat load given the pre and post conditions. Since the slope insulation was apparently not cost effective, this measure should be removed in its entirety.

These adjustments result in a reduction in annual kWh savings of 3,752 kWh/yr, from 6,975 kWh/yr to 3,223 kWh/yr.

b) Title: REM Project 5591

Projectid: J00000223511

MAS90: 6036-5591

This project involved a space heating fuel switching in a second-floor apartment. Due to a change in occupancy, billing history was not available and heat loss calculations were used to estimate the savings for this measure. Total annual savings claimed come to 9,871 kWh.

EVT made a reasonable adjustment to account for the potential use of remaining baseboard and the lower energy use due to the benefits of a second floor apartment located above conditioned space. However, EVT also made an error in converting from MMBtu to kWh.

The total heat loss is estimated at 10,141 kWh per year from the heat loss calculations, without any discounting for baseboard left in place and for lower heating needs in second floor apartments. Applying the 75% discount factor used by EVT to address these issues results in savings of about 7,606 kWh.

The annual kWh savings claim should be reduced by 2,265 gross annualized kWh, from 9,871 kWh/yr to 7,606 kWh/yr.

c) Title: REM Project 5829

Projectid: J00000225661

MAS90: 6036-5829

This project involved a space heating fuel switching. The occupant is no longer able to continue to use wood heat due to a medical condition and would have to start using the electric baseboard heat if no other action were taken.

In this case, billing analysis is not an effective mechanism for estimating savings. According to the agreement between EVT and the DPS negotiated through the TAG process in 2006, heat loss calculations should be used and these savings should then be discounted by 65% to account for potential future use of the wood stove over the 30 year life of the measure.

The Department does not agree that the calculations used by EVT in this situation are sufficient for modeling the heat load of the home. In addition, the 65% adjustment was not made. The Department's corrections result in adjusted savings of 11,944, for a total reduction of 10,011 gross annualized kWh.

d) Lighting

Savings for lighting in the LISF and REM initiatives are estimated based on the hours of use reported by the participants. About 592 gross annualized MWh are associated with lighting measures in the two residential existing homes initiatives.

Recent studies indicate that self-reported hours of use tend to be overstated on average. Examples include an extensive lighting metering study done by KEMA in California (2005) and an earlier lighting logger study in New England conducted by Nexus Marketing Research (2004). The Nexus Marketing Research study directly compared hours of use reported during on-site visits to the hours measured by the light loggers.

While EVT has instituted some internal controls to try to ensure these estimates are within a reasonable range, it is not possible to assess the actual impacts of these efforts.

The Department has reduced these savings by 20% to account for the self-reporting bias, as supported by the Nexus Marketing Research study, resulting in a total reduction of 118,320 gross annual kWh.

III. Projects with Pending Adjustments

A. CFL Measure Life

EVT bases the measure life for all CFLs on 10,000 hours, as is consistent with the TRM. However, the variety of products offered manufacturers has increased tremendously as bulbs have been designed and marketed for a wide variety of applications. While this is indicative of the great deal of success that EVT and other public benefit programs have had in transforming the market, it has also created some technological differences in the bulbs that need to be considered. CFLs offered today have expected lives ranging from 6,000 hours to 15,000 hours. The standard assumption for the life expectancy of 10,000 hours is no longer valid.

It was not possible to verify the life expectancy of many of the bulbs in the EP program. For instance almost 22% of the bulbs in the database list Home Depot as the manufacturer. However, a check of two brands with significant EP bulb sales illustrates this issue. The majority of MaxLite CFLs were listed as having 3 model numbers and all of these had a rated life of 10,000 hours. These represent 33% of the lamps sold. Almost all of the General Electric lamps that we were able to identify have a life expectancy of 8,000 hours. These lamps account for almost 20% of all purchases and over 99% of the GE lamps identified.

Additionally, in response to an inquiry EVT indicated that “*Some Negotiated Cooperative Partnerships (NCP) agreements specify CFL life. When this is done, the value is typically 8,000 hours.*” In the same response EVT indicated that 26% of bulbs rebated in quantities over 1000 were under such agreements.

Considering only the bulbs in our analysis with known rated lifetime hours, the average life would be approximately 9,200 hours, or an 8% reduction. At this point, it is not possible to determine whether a full accounting of EVT’s bulb purchases would lead to the same result.

The Department requests that EVT calculate savings based on the life expectancy of rebated lamps and adjust lifetime kWh savings accordingly. For 2006 the lifetime of CFL bulbs should be reduced to 9,200 hours. Lifetime savings and the TRB will need to be adjusted accordingly.

IV. Issues to be Addressed on a Prospective Basis

A. Documentation of Project Costs

EVT's "BES Project Review and Documentation Guidelines" state that files should include "*Equipment invoice or other documentation of installation and project costs.*" The Department assumes "other documentation" could include copies of signed contracts between participant and vendor that clearly specify cost or some other proof of cost/payment.

This level of documentation was missing from many project files and measure costs recorded in the database do not necessarily match the invoices that were found or even notes in project files. There are also other indications that the recorded measure costs are not reliable. One (hopefully atypical) example is the VFDs installed at the Saputo cheese factory. The measure costs were entered into the database as \$63,000. In this case, the file contained documentation that indicated only about \$23,000 of these costs is related to the VFDs. A large part of the extra costs was associated with demand control equipment that was completely unrelated to the VFDs and not included as an EVT measure.

Total measure costs are used for screening. While the initial screening and incentive offers may be based on quotes, the final screening determines whether the measure is cost effective and many of the database inputs are affected by the cost of the measure. Inaccurate costs can lead to incorrect decisions regarding cost effectiveness and the claiming of savings for measures that may not be cost effective by the societal test.

All measure costs (EVT, participant, and third-party) are included in the annual report to quantify the amounts invested in response to EVT's efforts. These costs are used to calculate the average cost of efficiency and may be used by third parties to summarize energy efficiency efforts in the state.

Invoice copies are also an important component of the verification process. They provide detailed information and proof of purchase for the actual equipment installed. In general, access to invoice copies can greatly streamline the verification process. At the Columbia Forest site visit plant personnel indicated that the installed compressor capacity was 200 hp rather than 125 hp. It was not possible to confirm this as the compressor was in a noise reduction enclosure. However a copy of the paid invoice would have provided the needed information.

It is important to have accurate documentation for all three of these purposes. The DPS recommends that EVT take steps to improve compliance with its guidelines and ensure complete documentation of measure costs in the files. Invoices for actual costs should be copied and kept in the files. Further, EVT should consider upgrading the error checking on these fields to improve the accuracy of the information kept in the central database system.

B. Other Documentation Issues

There continues to be a lack of other critical documentation in some project files. In some cases, such as the Comfort Inn, savings calculations were not found in the files originally provided. The Eastwood Commons project had insufficient information to calculate shell measures independently and truly verify the savings. These issues were all discussed in the 2005 Verification report and continue to be problematic. The DPS provided a list of information needed in project documentation that included savings methodology, assumptions, recommendations, bids, contracts and inspection forms. EVT

has policies in place to document projects and the Department would like to see them consistently implemented across all projects.

C. EP Lighting Products

In the course of this review, a number of issues arose regarding the CFL products sold through the Efficient Products initiative, and the Department proposes to revisit these issues through the TAG process in 2007. One issue is the rated lifetime of the bulbs. The standard 10,000 hours documented in the TRM no longer seems like a reasonable assumption, given the wide variety of products currently available.

As more bulbs are moved through the "buy down" process, EVT has less and less information about the disposition of individual bulbs. One related issue is the distribution of bulbs between commercial and residential purchases. For 2006, EVT made the distribution on the basis of historical data, using the break out by zip code to assign bulbs to commercial or residential purchases. This process is likely not acceptable moving forward.

Another issue is the over-limit purchases, in which large quantities of the product are purchased and little is known about the disposition. Although the EP program is not the appropriate mechanism for large-scale purchases, EVT does not have the ability to completely prevent this activity. It seems likely that a significant proportion of these products will be stocked for future use.

A further consideration is whether we have moved into the advanced stages of market transformation. The acceptance and availability of these CFL products has increased dramatically over the past ten years, accompanied by substantial reductions in price. At some point, it should no longer be necessary to offer incentives for these products. At the same time, other efficient lighting products, such as LED's, are starting to reach the market and may be appropriate for EVT's marketing efforts. These topics are appropriate for the TAG process.

D. CFL Products in Lodging Establishments

The DPS review indicates there is a wide range of strategies for handling the savings from CFL products that are installed in hotels, motels, inns and other lodging establishments. Some project managers are conscientious about addressing the various issues, and in other cases the standard commercial savings are used, apparently without further consideration.

In-room lighting is much more likely to be similar to residential use than commercial. Occupancy rates need to be considered, as well as a diversity factor when many bulbs are installed in each room. Another issue is the loss of CFL screw-in bulbs, as some patrons remove them from the lodging establishment.

The Department recommends that guidelines be developed so that a consistent strategy is used across all of the relevant programs and projects. This topic could be taken up in the 2007 TAG.

E. Opportunities for Continuous Monitoring

At the Ethan Allen and Columbia Forest site visits, DPS consultants noted that the VFD equipment installed is capable of providing continuous monitoring of power consumption. Our understanding is that the additional cost of gathering this information would be minimal and would not only improve our ability to verify energy savings but would also provide facilities management an important tool to monitor their operations and retain the benefits of the installed equipment. The DPS recommends that EVT investigate this potential and consider advising participants on the benefits of continuous monitoring of this equipment.

F. Improved Tool Documentation

EVT has developed a broad spectrum of spreadsheet-based tools that are being used to calculate energy savings. We recognize that this represent a considerable effort on EVT's part and realize that EVT tries to insure the accuracy of these tools. Unfortunately, reviewing the calculations in these tools can become very time consuming when they lack documentation and are not transparent. The Department requests that EVT clearly state within a tool the assumptions, formulas and source of other inputs being used. An explanation of the methodology chosen and the rational for the choice is also helpful.

G. Manufacturing Facility Operation Schedules

As illustrated by the Ethan Allen site visit, the number of shifts in production facilities varies depending on the demand for a product. Consequently, using the current operating schedule may result in savings that are too high or too low as an average over the life of the measure.

The cyclical nature of many businesses is admittedly difficult to predict. However many industries, such as furniture manufacturing, are cyclical by nature and neglecting the business cycle increases the uncertainty in savings estimates. The number of shifts at a facility may also change as product lines evolve and production is moved to or from a facility. The DPS would like to work with EVT to address this issue on an ongoing basis.

H. CAS Leak Corrections

EVT seems to be defaulting to the assumption that correcting leaks at a facility results in a 20% reduction in compressed air use. We understand the basis for this assumption is the Compressed Air Challenge. Their fact sheet number 7 states that: "Leaks can be a significant source of wasted energy in an industrial compressed air system, sometimes wasting 20-30% of a compressor's output. A typical plant that has not been well maintained will likely have a leak rate equal to 20% of total compressed air production

capacity. On the other hand, proactive leak detection and repair can reduce leaks to less than 10% of compressor output.”

While this is undoubtedly true, exclusive reliance on the 20% assumption ignores existing conditions before leaks are corrected and implicitly assumes that all plants are very poorly maintained. However, the DPS also acknowledges that trying to develop exact savings estimates is likely to be highly time consuming and probably not worth the amount of time and effort.

An alternative approach would be to develop a scale based on the condition of the air distribution system prior to the correction. For instance, a plant with a well maintained air system might only realize a 5% reduction in air use from leak detection and correction while a poorly maintained system could reasonably be expected to save 20%.

The DPS requests that this issue be placed on the TAG agenda for 2007.

V. Sampling Methodology

A stratified random sample was selected from EVT’s 831 C&I and 31 residential MFB projects. Sampling was conducted by project and the strata were defined according to the total annual energy savings for each project. There is reason to believe this approach provides sufficient sampling precision for the other performance indicators (TRB, summer and winter coincident peak demand savings and lifetime kWh). The samples were selected independently for the Business New Construction (BNC) and Business Existing Facilities (BEF) initiatives, for custom and prescriptive projects within the BEF and for the residential MFB projects. The specifics of the sampling strategy are listed below.

- The allocation of the sample to BNC, custom BEF and prescriptive BEF was initially determined approximately in accordance with the total annual energy savings associated with each initiative, and then adjusted to ensure an adequate sample within each category.
- The sample was checked to see if the lighting savings are roughly proportional to the initiatives as a whole and to ensure that it included most of the market tracks represented in the total population of C&I projects.
- A census of the largest projects in the custom BEF, prescriptive BEF and BNC initiatives were reviewed.
- For the most part, the cut offs for the strata and the sample sizes within each stratum were determined according to the methodology presented in the California Evaluation Framework.²

A few compromises were made in the sampling process for the BEF prescriptive track and the MFB projects. The BEF prescriptive, BNC and MFB projects were over-sampled to ensure an adequate sample size. For the BEF and MFB projects, the top tiers were established by inspection of the data. The California Framework method would have

² TecMarket Works, et. al. The California Evaluation Framework. Project Number: K2033910. Prepared for the California Public Utilities Commission and the Project Advisory Group. June 2004. Pages 327 to 339 and 361 to 384.

required additional strata to create a small group of the largest projects in the top stratum, and this added level of complexity did not seem to be warranted. All of projects in the top tier were reviewed.

Table 7: Summary of Projects

	Total # of Projects	Total MWh Savings	% Of Savings	# Of Projects in Sample
BNC	86	3,991	17%	20
BEF Custom	290	15,869	66%	46
BEF Prescriptive	455	2,921	12%	15
RES MFB	31	1,191	5%	7
Totals	862	23,971		88

As also occurred in the 2005 verification process, the first sample selected did not adequately represent the variety of end uses for the BEF prescriptive track. For this reasons, sampling of projects was conducted a second time and this second round produced a more evenly distributed sample.

The distribution of sampled projects in terms of the size of the projects is presented below in Table 8. This analysis shows that projects vary in size from 2 to 1,078,535 annualized kWh. The strata reflect a reasonable grouping of projects by size. In the commercial sector, the sample projects account for about 50% of total energy savings, KW winter savings and KW summer savings. For the residential multifamily projects, the sample represents about 50% of the energy and summer demand savings and 35% of the winter demand savings.

Table 8: Distribution of Sample by Project Size

	Stratum	# Of Projects	Min (kWh Savings)	Max (kWh Savings)	Mean (kWh Savings)	# Projects in Sample
BNC	1	51	537	36,111	14,269	5
BNC	2	18	38,640	62,788	48,867	5
BNC	3	11	65,861	158,338	89,520	5
BNC	4	5	159,333	504,580	279,734	5
Subtotal BNC		85	537	504,580	46,949	20
BEF Custom	1	196	163	46,230	13,657	12
BEF Custom	2	43	47,533	124,345	83,459	12
BEF Custom	3	24	124,514	243,901	168,270	12
BEF Custom	4	10	270,515	1,078,535	556,456	10
Subtotal Custom		273	163	1,078,535	58,127	46
BEF Prescriptive	1	402	2	15,451	2,763	5
BEF Prescriptive	2	48	15,622	58,857	23,739	5
BEF Prescriptive	3	5	63,466	396,154	134,117	5
Subtotal Prescriptive		455	2	369,154	6,420	15
Res MFB	1	29	286	90,369	27,899	5
Res MFB	2	2	155,540	226,563	191,051	2
Subtotal MFB		31	286	226,563	38,425	7
Total		844	2	1,078,535	37,158	88

This sampling strategy produced realization rates within a reasonable level of precision, with the relative precision of 12.3%, 2.2% and 10.4% at the 90% confidence level for the custom Business Existing Facility (BEF), prescriptive BEF and Business New Construction (BNC) projects, respectively.